REMARKS

Claims 1-27, 29-34, 36, 37, 38-41, 43, 44, and 46-79 are submitted for consideration. Claims 28, 35, 37, 42, 45 and 80-104 had previously been submitted for withdrawal in response to a prior Election of Species.

Claims 19, 22, 37, 39, 44, 49, 50, 51, 52, 66, and 76 are currently amended. No claim is cancelled.

Claims 19-21, 28, 48-50 and 79 are rejected under 35 U.S.C. § 102(e) as being anticipated by Marinca US2004/0,124,822 (herein after, Marinca). Specifically, the Office Action asserts that Marinca discloses a temperature compensation circuit. Applicants respectfully disagree and point out that Marinca does not show a temperature compensation circuit, but rather shows a temperature invariant, reference voltage circuit. That is, Marinca does not show a circuit that produces a control signal that varies with temperature in such a manner so as to counteract the temperature variations of another circuit, as is the general understanding of a temperature compensation circuit. Rather, Marinca shows a circuit that ideally produces a constant voltage output that does *not* vary with temperature. This distinction is not subtle.

A temperature compensation circuit produces a compensation signal that varies with temperature in a manner ideally intended to counteract the temperature drift of a second circuit. That is, if the second circuit tends to slow down (or produce a lower magnitude output) as temperature increases, then the temperature compensation circuit should output a control signal that changes with temperature so as cause the second circuit to speed up (or cause its output magnitude to increase) as temperature raises in such a manner so as to ideally, cancel (i.e. counteract) the second circuit's inherent temperature drift. Similarly if the second circuit tends to speed up (or produce a higher magnitude output) with lowering temperature, then compensation circuit should output a control signal that changes with temperature so as cause the second circuit to slow down (or cause its output magnitude to decrease) as temperature drops in such a manner so as to ideally cancel (i.e. counteract) the second circuit's inherent temperature drift.

By contrast, a the output of a temperature invariant, voltage reference source is ideally intended to remain unchanged over a wide range of temperatures. If the output of the reference voltage source is use to control a second circuit (and if the behavior of the second circuit is dependent primarily upon the output from the temperature invariant, reference voltage source), then it is assumed that the behavior of the second circuit will not change with temperature as long as the output from the voltage reference source remains constant. This, of course, ignores any changes in the second circuit due to temperature drift since the constant output from the reference voltage source cannot counteract such drift effects.

Thus it is self-evident that the behavior, and objective, of a temperature compensation circuit and of a temperature invariant, reference voltage source are directly opposed to each other.

Marinca explains that his temperature invariant, constant voltage source is of the bandgap type, which is the most common type used in integrated circuits. Marinca further explains in his paragraph [0002], that all bandgap voltage references use a combination of a CTAT reference and a PTAT reference to cancel out temperature variations. A better understanding of bandgap circuits can be obtained from text book, "The Design of CMOS Radio-Frequency Integrated Circuits", Second Edition, by Thomas H. Lee, ©Cambridge University Press 1998, second edition first published 2004, pages 318-328, (Exhibit A). Specifically, the third to seventh paragraphs on page 318 of Exhibit A explains that,

> "Because IC technology directly offers no reference voltages that are inherently constant, the only practical option is to combine two voltages with precisely complementary temperature behavior. Thus, the general recipe for making temperature independent references is to add a voltage that goes up with temperature to one that goes down with temperature. If the two slopes cancel, the sum will be independent of temperature.
>
> Without question, the most elegant realization of this idea is the bandgap voltage reference. ....

Recall that VBE is nearly perfectly CTAT (i.e., it goes down linearly with temperature). Now suppose we add to this CTAT VBE a voltage that is perfectly proportional to absolute temperature (PTAT). <u>If we choose the slope of the PTAT term equal in magnitude to that of the CTAT term, the sum will be independent of temperature (see Figure 10.6).</u> We see that something funny happens above about 600 K, but the fact that the principle fails at temperatures high enough to melt lead is rarely a practical concern.

Note that the addition of a PTAT and CTAT voltage in the proper ratio yields an output equal to the bandgap voltage (extrapolated to 0 K), independent of temperature. Stated another way, if we adjust the PTAT component to make the output voltage equal to VG0 at any temperature, then the output voltage will equal VG0 at all temperatures at least in this slightly simplified picture."

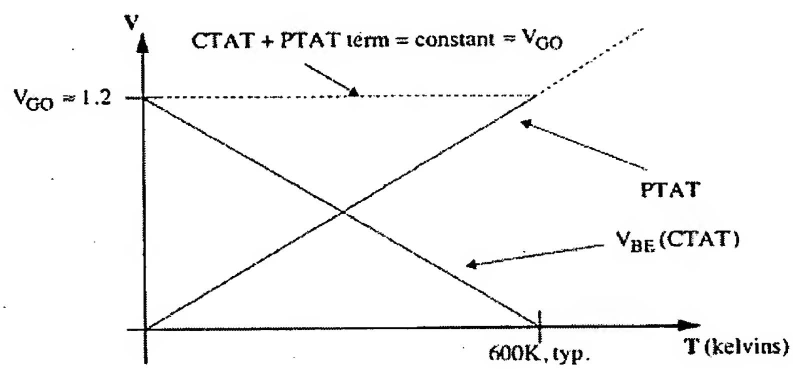

FIGURE 10.6. Illustration of bandgap reference principle.

From the above excerpt, and from Figure 10.6, it is self-apparent that the objective of a bandgap voltage reference is to produce a constant voltage V_{GO}. Figure 10.6 further show that no temperature offset is desired since the objective is to cancel a transistor's VBE temperature drift over its entire operating range (i.e. starting at 0° Kelvin (i.e. absolute zero) and continuing up until the transistor's practical operating temperature). Both of these observations are contrary to two Office Action's assertions.

Before addressing these two Office Action assertions, however, it may be prudent to first address a concern raised by the Office Action. On the last paragraph of page 2 of the current Office Action, (paper 20051106), it is stated that,

> "...As to the limitations that the first temperature dependent current signal generator being effective for producing a first current signal proportional to temperature when the temperature is not lower than the first activation temperature and for producing substantially no signal when the temperature is below the first activation temperature. Firstly the claims do not define what the first activation temperature is and thus this can be any temperature and there is a temperature where the proportional to temperature current generator will not generate a substantial current. The second similar limitation "said second temperature dependent signal generator produces said second current signal when temperature is not lower than said second activation temperature" has the claims not defining exact what temperature the second activation temperature is. Thus this can be any temperature. Also note that like above the second activation temperature can be so low that substantially no current flows. ..."

Here, the Office Action appears to identify 0° Kelvin, the lowest physical temperature as shown in Figure 10.6, above, as the first and second activation temperatures since at this temperature all physical movement (including electron movement) would theoretically stop. Applicants have addressed this broad reading of the claims by amending claim 19, 49 and 50 to recite "a <u>selectable </u>first activation temperature" and "<u>a selectable </u>second activation temperature". Thus, it is made clear that the first and second activation temperatures are not mere physical limitations due to a device's natural operating temperature range, but are a <u>*selectable*</u> starting point within the device's natural operating temperature range. This limitation precludes the natural temperature at which current flow naturally begins since this natural temperature is not selectable, but rather is an inherent characteristic of the device's physical elements.

Returning now to the two Office Action assertions alluded to above, the first of these assertions is made in the second paragraph of page 3 of the current Office Action, wherein it states:

> " As shown in figure 1 <u>in order to compensate for this curve the proportional to temperature curve would have to be on the "high" temperature side and the inverse to temperature curve would have to be on the low temperature side.</u> Thus when the temperature is

> low the proportional current generated is low as the current is proportional to temperature. However, when the temperature is low the inverse of this would be high and thus the inverse to temperature generator generates a high current when the temperature is low. Accordingly, the inverse temperature generator is activated at a lower temperature than the proportional current generator."

The above excerpt makes two assertions. First, it asserts that the curve of Fig. 1 is a temperature characteristic curve of a circuit to which a temperature compensation signal in accord with Marinca's invention will be applied. Secondly, it asserts that temperature drift is cancelled by providing circuits having activatable temperature compensation curves. Both of this assertion are contrary to Marinca's teachings.

In regards to the first assertion, Fig. 1 shows the output from the Marinca's prior art, bandgap, reference voltage source. That is, this is not the temperature drift curve of a second circuit that to which a temperature compensation signal is to be applied. Rather, it is the output from a poor, prior art, bandgap reference voltage source, itself.

In paragraph 3, Marinca explains that the prior art reference voltage source, whose output is shown in his Fig. 1, is independent of temperature only to a first order, and demonstrate a logarithmic curve (TlnT) due to second order, and higher effects resulting in the curve of Fig. 1. Marinca then explains that the addition of a logarithmic canceling circuit can cancel this logarithmic effect and result in a more straight line. However, this added compensation circuit is not easily incorporated into an integrated circuit. Thus, Marinca shows in his invention a logarithmic canceling circuit that can readily be incorporated into a CMOS integrated circuit process. Specifically, Marinca state,:

> "[0003] An example of one such voltage reference circuit is described in New Developments in IC Voltage Regulators, IEEE Journal of Solid-State Circuits Vol SC-6 No 1 February 1971, pages 2-7. However one of the problems associated with this traditional voltage reference circuit is that although the bandgap voltage output is independent of temperature to a first order, the output of this standard circuit is found to include a term that varies with TlnT, where T is absolute temperature and "In" is the natural logarithm function. FIG.

> 1 is a graph showing an example of the output voltage of such a circuit. It is apparent that the output exhibits a "bow-shape" response. This curvature indicates that the reference voltage does not remain constant over a range of temperatures and ***therefore fails to achieve the ideal*** of a ***temperature independent voltage reference***."

Paragraph [0003] thus clearly states that the graph of Fig. 1 is not a circuit to be compensated, but is the output of what was supposed to be a temperature independent voltage source. Paragraphs [0004] and [0007] then explain:

> "[0004] A modification to overcome this problem was proposed by Jonathan M. Audy and is described in U.S. Pat. No. 5,352,973, assigned to the assignee of the present invention. In this patent Audy describes how to cancel the curvature ***by compensating for the TlnT term***. It is achieved by adding a correction circuit to the standard bandgap implementation. ...
>
> [0005] While this aforementioned circuit substantially eliminates the curvature effect in the output voltage, there is one drawback associated with its implementation. ... In a standard CMOS process generally only two types of bipolar transistors are available--a parasitic substrate bipolar transistor device with one terminal permanently connected to the substrate, and a lateral bipolar transistor device which has very poor performance. Therefore this implementation could not be directly implemented in standard CMOS." ...
>
> [0007] These needs and others are addressed by the curvature correction scheme of the present invention which provides for a bandgap voltage reference circuit implemented in CMOS technology."

Paragraphs [0004] to [0007] clearly explains that Marinca's invention counteract the logarithmic effects of a bandgap reference voltage source by providing a circuit that compensates for the TlnT term.

Thus, it should be clear that Marinca does not teach or suggest two temperature dependent signal generator, each having respectively selectable activation temperature, wherein the respectively selectable activation temperatures are selected to cancel selected regions of a second circuit's characteristic temperature drift curve.

Furthermore, although bandgap, reference voltage sources achieve ideally constant voltage outputs (contrary to the present invention) by adding the effects

of PTAT and CTAT components, they do not teach or suggest any selectable temperature activation points for providing temperature offset effects, as is required in the present invention. This is clear from Figure 10.6 of Exhibit A, wherein it is shown that the constant (i.e. temperature invariant) reference voltage V_{GO} is obtained by adding a PTAT reference and a CTAT reference with ***no*** temperature offset in either PTAT or CTAT component. Additionally, it is noted that a bandgap, reference voltage source, such as Marinca's, ideally outputs a constant (i.e. not changing with temperature) voltage, which is in direct conflict with the present invention.

Claims 19, 20, 21, and 48 were further rejected under 102(b) as being anticipated by U.S. Pat. 3,483,485 to Scherrer. As is explained above, claim 19 has been amended to more clearly recite "a first temperature dependent signal generator having a selectable first activation temperature" and a second temperature dependent signal generator having a selectable second activation temperature. Scherrer explains that his compensation circuit uses an attenuator consisting of a resister and a thermister to achieve a desired gain, Gt=V2/V1 (col. 3, lines 11-14), and that his compensation circuit is adjustable by adjusting the resistance of the resister and the gain (col. 3, lines 20-29). As it is known in the art, resisters and thermisters (i.e. thermally sensitive resisters) do not have selectable activation temperatures. Thus, no where does Scherrer show or suggest the summing of a first signal proportional to temperature having a selectable first activation temperature with a second signal inversely proportional to temperature having a selectable second activation temperature, to produce a temperature compensation signal.

Claims 46 and 47 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Scherrer (U.S. Pat. 3,483,485) in view of Toncich et al. (US2002/0149434). Specifically, Toncich is cited as showing a an oscillator having a variable frequency function. Applicants respectfully point out neither Scherrer nor Toncich, singularly or combination teach or suggest the summing of a first signal proportional to temperature having a selectable first activation temperature with a second signal inversely proportional to temperature having a

selectable second activation temperature, to produce a temperature compensation signal.

Claims 1, 2, 5, 7, 9, 11-16, and 18 are provisionally rejected on the ground of non-statutory obviousness-type double patenting as being unpatentable over claims 18-28, 47-57 and 72-81 of co-pending Application No. 10/733,094. However, no other grounds for rejection are given, leading Applicants to assume that claims 1, 2, 5, 7, 9, 11-16, and 18 would be patentable if a terminal disclaimer were to be filed in co-pending Application No. 10/733,094. If this is correct, Applicants would be willing to file a terminal disclaimer in co-pending Application No. 10/733,094. Applicants request that the Examiner clarify if any other issues impede the patentability of claims 1, 2, 5, 7, 9, 11-16, and 18.

Claims 3, 4, 6, 8, 10, 17, 22-27, 29-34, 36, 37, 39-41, 43, 44, and 52-78 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form. Applicants thank the Examiner, and a have amended some of these claim, accordingly, as summarized below.

Applicants reserve the right to rewrite claims 3, 4, 6, 8, 10, and 17 in independent form at a later time following the Examiner's clarification of the rejection status of claims 1, 2, 5, 7, 9, 11-16, and 18.

Claim 22 is rewritten in independent form, including all the limitations of its base claim 19. Claims 23-36, which depend from claim 22 are thus believed to be in condition for allowance based at least on the allowability of their base claim 22.

Applicants had previously submitted claim 37 for withdrawal, but it would appear that the Examiner has rejected withdrawal of claim 37 since the present Office Action considers claim 37 and deems it allowable, if rewritten in independent form. Applicants thank the Examiner, and have amended claim 37 to be in independent form. Claim 37 is now believed to be in condition for allowance.

Claim 39 is rewritten in independent form including all the limitations of its base claim 19, and is believed to now be in condition for allowance. Claims

40-43, which depend from claim 19 are likewise believed to be in condition for allowance based at least on the allowability of their base claim 39.

Claim 44 is rewritten in independent form, including all the limitations of its base claim 19, as originally filed, and is believed to now be in condition for allowance. Claims 45-48, which depend from claim 44 are likewise believed to be in condition for allowance based at least on the allowability of their base claim 44.

Claim 52 is rewritten in independent form including all the limitations of its base claim 49, as originally filed, and is believed to now be in condition for allowance. Claims 53-65 are likewise believed to be in condition for allowance based at least on the allowability of their base claim 52.

Claim 66 is rewritten in independent form including all the limitations of its base claim 49, as originally filed, and is believed to now be in condition for allowance. Claims 67-75 are believed to be in condition for allowance based at least on the allowability of their base claim 66.

Claim 76 is rewritten in independent form including all the limitations of its base claim 49, as originally filed, and is believed to now be in condition for allowance. Claims 77 and 78 are believed to be in condition for allowance based at least on the allowability of their base claim 76.

In view of the foregoing amendments and remarks, Applicants respectfully request favorable reconsideration of the present application.

Respectfully submitted,

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